mission following cloudiness would in general be carried on by all three portions, but the evidence here presented suggests that the first portion, added to the third, both feebly absorbed, is of great importance.

Since completing this paper the writer has read an interesting account by Nipher, in the Proceedings of the Saint Louis Academy of Sciences, 1913, of local magnetic storms whose origin he believes to have traced to the influence of clouds. He finds also a period of magnetic disturbances coinciding with the well-known twilight fluctuations in radiotransmission. Prof. Nipher suggests a variation in the ionization of the *lower* levels caused by variations in the sunlight as the nature of this influence. There seems to be an intimate connection between these phenomena and the variations in radiotransmission.

Number.	Station.	Longitude. 1	First Phase. Arrival. 2	First Phase. Maximum. 3	First Phase. Principal maximum. 4	Second Phase. Arrival. 5	Second Phase. Maximum. 6	Second Phase. Principal maximum. 7
		West. ° ′	1912.			1912.		
1	Katmai	155 0	June 6, eruption					
2	Mount Wilson	119 10				June 21, haze; July 1, actinom	July 4	No
3	Washington	77 0	June 10, haze					Aug. 15
4	West Greenland	50 0	After June 15; Before June 21					
5	Iceland	21 52	June 16	Between June 17-July 1	No	July 1-26		*
		East.						
6	Algiers	4 0	June 19, haze; June 28-30, actin	July 6	No	July 11	July 11-20	No
7	Heidelberg	8 42	June 20, twilight	July 8-11	No	July 19	July 20-25	No
8	Zurich	8 33	June 23, vapor veil	July 12				
9	Hamburg	10 0	June 23, twilight					
10	Denmark	10 0	June 23	July 11	Yes; end of July	July 21	July 22; July 28	July 11
11	Pavia	9 10	June 27	July 11	Sept. 15	Absent	Absent	Absent
12	Salo	10 31	June 27	June 27	July 22	July 22	July 23	June 27
13	Ischia	13 50	June 24	July 9-12	No	July 24	July 27	Yes
14	Innsbruck	11 25	June 23	July 6-12, or later	No	Absent	Absent	Absent
15	Potsdam	13 0	June 24-27	July 10-15	Yes; like late summer	July 26	July 26; Aug. 1	Like July 10
16	Triest	13 50	June 24	July 13	Yes	July 28 (?)	(?)	No
17	Donnersberg	13 50	June 28	July 12-16	No	Indefinite (?)	Aug. 5 (?)	No
18	Tetschen	14 15	June 23	July 11-15	Yes	Absent	Absent	Absent
19	Fiume	14 25	June 28	July 15	No	July 24	July 24	Yes
20	Vienna	16 25	June 25-29	July 12-18	Yes; Aug. 1	July 28	July 28-Aug. 1	Yes; July
21	Häfringe	17 19	June 29	July 21	Yes	Absent		
22	Warsaw	21 01	June 26	July 26, after gaps	Yes; Aug. 22-Oct. 1	Aug. 2	Aug. 2-22	July 26-Oct. 1
23	Przegaliny	22 48	June 22 (?)	July 26	Yes	Absent	Absent	Absent
24	Sophia	23 15	June 26					
25	Athens	23 43	June 17	Increasing to Aug. 5	Oct. 1	Aug. 5	Aug. 5	Oct. 1
26	Egypt	31 0	June 28	July 3	No	Aug. 8	Aug. 8	Sept. 9

MAURER & DORNO ON THE PROGRESS AND GEOGRAPHICAL DISTRIBUTION OF THE ATMOSPHERIC-OPTICAL DISTURBANCE OF 1912-13.[1]

In January, 1913, Prof. J. Maurer of Zurich sent out, in his capacity as chairman of the Solar Radiation Commission of the International Meteorological Committee, a circular letter[2] requesting the meteorological institutes and bureaus of the world to compile and send to his commission complete details of observations that would help the study of the great atmospheric opacity which appeared over the Northern Hemisphere in 1912. A large amount of material was received in response to that request, and was placed in the hands of Maurer (Zurich) and C. Dorno (Davos) for discussion. The following paragraphs attempt to summarize the results as presented by the two authors in the paper first cited.

MATERIAL.

The first step in the discussion was to collect the records of the Campbell-Stokes sunshine recorders for those days of 1912 which yielded well-defined traces. These were compared with the records for the same localities on corresponding days of average or normal years; the best years immediately preceding 1912 were chosen as these standards of comparison. Of course there had been considerable variations in judgment of what constituted the beginning of the daily record-trace, in exposures and in instrumental peculiarities among so many contributing institutions. Particular difficulty arose in endeavoring to estimate the effects of low-lying haze and fog upon the Italian records. Eventually, however, the comparisons yielded a quantity of differences in the times of beginning of each day's record for 1912 as compared with the corresponding data for average years. These differences were then carefully reworked graphically by Dorno.

Then the actinometric and polarization observations were gone over in an equally careful, critical manner. The actinometer records were studied by comparing the daily maxima throughout 1912 with the average maxima for corresponding days and the resulting differences were plotted. In the polarization records the maximum and the minimum values of the antisolar distance of Arago's Point for 1912 were similarly compared with the average values for normal years. Finally all manuscripts and published notes on the sky were carefully compared with the plotted curves; the curves obtained from the sunshine recorders were supplemented by those from the photo-recording station at Tetschen and by the curves from practically all the actinometric and polarimetric observatories of the world. In all 36 such curves were prepared and studied; selections from them are reproduced as figure 1 of the article noticed, but must be omitted here.

[1] Summarized from: *Maurer, J., & Dorno, C.* Über den Verlauf und die geographische Verbreitung der atmosphärisch-optischen Störung, 1912-13. Met. Ztschr., Braunschweig, Feb. 1914, 31. Jhrg, pp. 49-62.

[2] See Meteorologische Zeitschrift, Braunschweig, Februar, 1913, 30. Jhrg, p. 92.

RESULTS OF COMPARISONS.

The results of the whole study are succinctly presented in Table 1. This list of phenomena includes, however, only those that may with certainty be ascribed to the eruption of Katmai volcano. So far as the incomplete and variable character of the material permitted, the phenomena have been correlated and arranged to show the sequence of events and the different phases. It was often difficult to properly distinguish the different phases because of locally veiling influences, and also owing to the discontinuous character of the high, bright clouds which formed the principal characteristic of the phenomenon. However, it seems possible to distinguish five phases in the development of the disturbance.

above North America. Their arrival above Europe was well observed at Heidelberg on June 20–21, at the observatory on the Zugspitze (lat. 47° 25′ N., long. 10° 59′ E., alt. 2964 m.) on June 22, and at Zurich on the 23d. At their front they were so delicate that the Campbell-Stokes recorders were not affected until greater thicknesses of the haze began arriving several days later. Column 2 of the table shows the dates of arrival of the advancing front, and the maximum of the first phase is shown in column 3.

Second phase.—The second wave of the phenomenon appeared over the northern Pacific coast of the United States on June 18. On June 21 it reached Mount Wilson in southern California, thus indicating that it was spreading farther south than did the first phase. Again

THIRD PHASE.			FOURTH PHASE.			CLEARING OFF.	NEW HAZINESS.	Number.
Arrival. 8	Maximum. 9	Principal maximum. 10	Arrival. 11	Maximum. 12	Principal maximum. 13	14	15	
July								1
July 19-26	Aug. 2	Yes	End of August	Reported	No	No report		2
		Aug. 15				Sept. 15–Oct. 15		3
								4
July 26	Aug. 7–16	Yes	Sept. 9	Sept. 9	No	Oct. 1–16	O. 16–25, report stops.	5
Aug. 1	Aug. 3	Yes	About Sept. 10	Ci-st		Ci-st. Sept. 15–Oct. 27.	Oct. 27–Nov. 10, report stops.	6
Aug. 10	Aug. 20	Yes	Sept. 12	Sept. 12	No	Oct. 9–15	Dec. 20	7
						Oct. 11		8
								9
Absent	Absent	Absent	Sept. 15	Sept. 18	No	Oct. 9–20		10
Absent	Aug. 29	Sept. 15	Sept. 14	Sept. 15	July 12–Aug. 29	Absent		11
Aug. 16	Aug. 8	Absent	Absent	Absent	Absent	Absent		12
Aug. 18	Aug. 18; Aug. 30	No	Sept. 17	Sept. 17	No	Absent		13
Absent	Absent	Absent	Sept. 18	Sept. 22–23	Yes	Oct. 7–23		14
Absent in part	Aug. 28	No	Sept. 12	Sept. 12	No	Oct. 4–Nov. 1	Nov. 6–30; Dec. 19	15
Aug. 18?	(?)	(?)	Absent	Absent	Absent	Gaps to Oct. 17		16
Beginning is absent	Sept. 9	Yes	Sept. 24 (gaps)	Sept. 24 (gaps)	No	Oct. 5–11		17
Aug. 18	Aug. 18	No	Absent	Absent	Absent	Oct. 21		18
Aug. 15, absent in part	Sept. 5	(?)	Sept. 15	Sept. 15	No	Oct. 5–15		19
Aug. 20	Aug. 20	No?	Absent	Absent	Absent	Absent		20
								21
Sept. 12?	Sept. 12	No?	Sept. 29	Sept. 29	Aug. 2–22	Oct. 5–Nov. 4	Nov. 4, Nov. 26, etc.	22
Aug. 25	Sept. 15	No	Not recognizable	Not recognizable	Not recognizable	Not recognizable	Not recognizable	23
								24
Increasing Sept. 1–30	Sept. 30	Aug. 5		Sept. 30	Aug. 5	Oct. 1–31	No change, slight effect.	25
Aug. 23–Sept. 8	Sept. 8	Yes	Sept. 23	Sept. 23	No	Clear, Sept. 30		26

First phase.—Immediately succeeding the first eruption of Katmai on June 6, 1912, the sea was pumice-covered in the vicinity of the volcano, there occurred an ash fall of 30 cm. depth even to a distance of 150 km. (93 mis.), and traces of ash fell at 1,500 km. (932 mis.). Corroding sulphuric acid in the air destroyed vegetation at a distance of 700 km. (435 mis.) and was still perceptible at 1,400 km. (870 mis.).

An unusual haze due to large numbers of condensation nuclei floating at low and intermediate levels was observed at Madison, Wis., on June 9 and 10, at Helena, Mont., and at Washington, D. C., on the 10th. As early as June 8, Madison, Wis., observed and described a very high cloud of vapor traveling rapidly eastward and having all the characteristics of the cloud later more generally observed; but it was broken up like a dissolving jet or stream and had not yet taken on its more compact form. Thus it appears the high, bright clouds were formed immediately upon the first eruption, and they best enable us to follow the course of the optical disturbance in its characteristically WNW–ESE movement. The velocity of the clouds agreed with the observed wind velocities prevailing its first character was that of very delicate, bright high vapor clouds barely able to exert any noticeable influence upon insolation intensities, and it was not until 8 or 10 days later that this element was strongly affected. The wave was characterized by a double crest of but a few days' interval, the second crest being higher [that is, the cloud was denser] than the first.

Third phase.—The third phase, represented by the data collected in columns 8, 9, and 10 of Table 1, might be regarded as the result of superposing phases 1 and 2. The striking peak in the curves for Iceland and many other localities might be said to point to a new eruption if one is disinclined to assume that upper air currents had drifted the masses together and just in this direction. Localities that are least subject to disturbing weather conditions have their principal maximum during this phase instead of the first phase, as did other places.

Fourth phase.—Many stations reported that there were signs of a clearing off in progress during the days just previous to the dates entered in column 11. The dissolution of the high, bright clouds seemed to be well advanced when they were reinforced by the eruption of August 19 [?].

A sharp drop in the various curves marks the appearance of this new cloudy condensation whose effects continued until mid-October. The time of its final disappearance depends upon the longitude of the respective localities.

Actinometric and optical observations show that a strongly absorptive foreign stratum persisted for some time after even mid-October. It thus becomes necessary when considering the phenomenon as a whole to distinguish between the visible, high, bright, cloudy condensation of hygroscopic origin at altitudes between 10 and 12 km., and the invisible absorbing stratum which consisted of the finest volcanic dust driven farther up into stratosphere levels which are less favorable to the hygroscopic growth of cirrus-like clouds.

The Campbell-Stokes sunshine recorders seem to have clearly demonstrated their general reliability, at any rate, in so far as the principal features of this disturbance were concerned.

Extent and intensity of the disturbance.

It appears that the disturbance of 1912–13 scarcely attained latitudes as high as 80° N. in Greenland, or as low as the Azores in about 40° N., where the Horse Latitudes seem to have called a sharp halt to the spreading cloud. It seems certain that in longitude the disturbance extended as far as central and northern Asia after crossing Europe. Reports from India leave us in doubt as to its further eastward extension, but the low intensities at Mount Wilson August 10–20, 1912, keep this question open. Additional reports from Batavia, Australia, Argentine Republic, and Chile show definitely that there was no general cosmic disturbance affecting the whole globe. So far as it is possible to correlate and compare the various measurements of decreased insolation, they agree with the general characters of the disturbance as outlined above. The intensity of insolation suffered least at such marginal points as Mount Wilson, Cal., and Bassour, Egypt, while the greatest weakening lay near the axis of the "shadow" as at Häfringe, Sweden, and Potsdam-Berlin, Germany.

WAS KATMAI ALONE RESPONSIBLE?

As has just been noted, there is no evidence of any general cosmic disturbance such as must have affected both hemispheres.

It appears certain that there were disturbances preceding the outbreak of Katmai on June 6. Stations in Egypt, Athens, Hungary, Poland, and Häfringe, all lying within narrow longitudinal limits, report disturbances between May 31 and June 6, which lag, weaken, and grow shorter from the south northward. It seems possible to trace small forerunners of this wholly independent pre-Katmai disturbance in the reports from Vienna, Tetschen, Potsdam, Toggenburg (Switzerland), Fiume, Pavia, etc., but it seems advisable not to give these hints too much weight. Some eruption in the Philippines at about this time, though reported subsequently, may here furnish an underlying cause. Stellar photometric work at the Vienna Astronomical Obsevatory was seriously interrupted during the period June 6–12, 1912, and this is certainly to be correlated with those eruptions.

CONDITIONS IN

Dorno's extensive Davos observations on sky polarization, twilight phenomena and Bishop's Ring, show plainly that the more pronounced disturbance endured through January, 1913. He found no distinct recovery of normal insolation intensities at Davos until February 9, 1913. Sky-light polarization, twilight phenomena, and notably the frequent glorious purple afterglows of November and December, 1913, occurrences of Bishop's Ring, and of peculiar glares about the sun, showed that conditions were not yet normal over Europe at the close of 1913.

These conditions emphasize the necessity for compiling and transmitting to the Solar Radiation Commission full reports to the close of 1913, and for continued careful observations through 1914.—[C. A., jr.]